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ABSTRACT

Jean Piaget's theory of cognitive development and David Ausubel's assimilation theory of learning are explicated and selected research involving both theories is reviewed in this paper. The two theories are compared on selected dimensions to demonstrate that they are compatible and that, in conjunction with one another, they form a strong theoretical base for explaining and predicting learning, retention, and transfer processes. Implications for further research and pedagogic applications are explored. (Author/FL)

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Comparative Evaluation of the Cognitive Theories of Piaget and Ausubel

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Running head: Comparing Piaget, Ausubel

Comparative Evaluation of the Cognitive Theories of Piaget and Ausubel

Cognition, the act or faculty of knowing, has been the object of investigation since ancient times. Two areas of cognition in particular, cognitive development and cognitive processes, have been studied extensively by biologists, psychologists, educators, and others. Naturally, the perspective from which the investigators approach their work affects their perceptions and conclusions. Although the study of cognition has a long history, the last two decades have witnessed a revived interest in intellective activities, especially in cognitive psychology. In the foreword to Human Development and Cognitive Processes, Hilgard lists five contributory causes of this resurgence: the launching of Sputnik, renewed interest in the psychology of language and language development, advances in computer technology permitting new experimentation in problem solving and thinking, interest in the later effects of early experience, and the broadened front of contemporary psychology (Eliot, 1971, pp. v-vi).

In the receptive milieu created by these trends, the writings of two men have received particular attention. Jean Piaget, a Swiss genetic epistomologist, has studied the cognitive development of children for more than half a century, mostly through observations of small numbers

of children in natural and controlled conditions. While his early work received only moderate acceptance and much criticism, he has now been recognized as one of the most influential living thinkers (Pulaski, 1971, p. ix). More recently, David Ausubel, an educational psychologist, has explored extensively the role of cognition in learning. His work has culminated in a cognitive theory of meaningful learning which he calls assimilation theory. Although interest in Piaget's work has been the greater of the two, both theories have generated considerable empirical investigation with mixed results. Recently a body of research has begun to accumulate which combines the two theories to generate unified, testable hypotheses. Interpretation and evaluation of the research, however, requires a clear understanding of the theories from which the hypotheses are deduced.

The purpose of this paper is first to explicate briefly Piaget's theory of cognitive development and Ausubel's assimilation theory of meaningful learning. (See Figures 1 and 2 for structured overviews used in the oral presentation of this paper.) The two theories will then be critically compared and contrasted. If major differences do not emerge, the theories will be considered compatible, forming a stronger theoretical base than either one alone. From this theoretical synthesis, implications for further research and pedagogic applications will be explored.

Piaget's Theory of Cognitive Development

Although the writings of Piaget have greatly influenced various disciplines including child psychology and education, he describes himself primarily as a genetic epistomologist. An understanding of this formidable label helps one to place Piaget's work into a manageable

framework. According to Flavell, who explicated Piaget's work in The Developmental Psychology of Jean Piaget (1963), "He regards himself as above all an epistemologist, one interested in the complex relation between knower and known and, more particularly, a genetic epistemologist, interested, in the very broadest possible sense, in historical-developmental changes in this knower-known relation" (Flavell, p. 250). To consider genetic epistemology as applied developmental psychology clarifies its essence; that is, Piaget has applied his developmental findings to classical epistemological problems (pp. 250-251). Not only does he include growth of knowledge in scientific fields such as math or logic, but he considers also the growth of knowledge in ontogenesis (the development of the individual organism).

Within this broad orientation rooted both in philosophy and biology, Piaget is "primarily interested in theoretical and experimental investigation of the qualitative development of intellectual structures (p. 151)". For Piaget these structures constitute the organizational properties of intelligence which, in turn, result from functioning and are discerned from the contents of individual behavior. "Function is concerned with the manner in which any organism makes cognitive progress; content refers to the external behavior which tells us that functioning has occurred; and structure refers to the inferred organizational properties which explain why this content rather than some other has occurred" (p. 18). A brief examination of the invariant functioning processes will provide a context for and a contrast with structure.

Cognitive functioning is biological in nature: humans inherit biological structures which prescribe their perceptions; concomitantly, they also inherit a mode of intellectual functioning which allows them somewhat to overcome physiological limitations through transactions with the environment and which remains essentially constant throughout life (pp. 42-43). Two prime attributes define this biologically based cognitive functioning: adaptation and organization.

The first of these attributes, adaptation, consists of interchanges between an organism and its environment which modify the organism to favor its preservation. Adaptation is a balance or equilibrium of the two dynamically interrelated processes of assimilation and accommodation. Assimilation is the taking in process by which one incorporates experiences into one's own activity; accommodation is the outgoing, adjusting process of reaching out to the environment (Pulaski, p. 7). The two processes are "simultaneous and indissociable as they operate in a[illegible]ing cognition" (Flavell, p. 48).

The process of adaptation occurs within the individual's internal organization, the second attribute of cognitive functioning. "Every act of intelligence presumes some kind of intellectual structure, some sort of organization, within which it proceeds" (p. 46). Although the nature of the organization changes structurally with development, organization as a totality or system of relations is presupposed as the foundation on which adaptation occurs; that is, assimilation and accommodation of an object or experience transpires within the context of an organization of some kind.

While Piaget posits this quasi-enduring organization which forms the context for adaptation, he utilizes another relatively stage-free structure as the means to relate the developmental stages of ontogenesis: schema. This transdevelopmental concept involves "a cognitive structure which has reference to a class of similar action sequences, these sequences of necessity being strong, bounded totalities in which the constituent behavioral elements are tightly interrelated" (p. 53). More simply stated, a schema is similar to a concept which subsumes a collection of similar action sequences; Piaget describes it as constituting "a sort of sensorimotor concept" (p. 54) or a "mobile frame" successively applied to various contents.

Schemata represent cognitive structures in a general, overall manner. However, these structures also have differing properties at various ontogenetic levels. Cognitive structures are "organizational properties of intelligence, organizations created through functioning and inferable from the behavior contents whose nature they determine" (p. 17). In other words, such structures are specifics of functional organization. Piaget has conceptually partitioned these constantly evolving structures into qualitatively different stages which reflect the developmental process.

Several critical aspects of the stage concept include: the reality of the construct, the invariant sequence of the stages, hierarchical relations between successive stages, the integrated character of the stages, preparation and achievement periods, and horizontal and vertical

décalages (pp. 19-24). First, unless the developmental process can be broken down into qualitatively distinct clusters of behaviors, the abstraction of stages becomes artificial and empty. Piaget has supported the distinct character of the stages through observation of behavior content. Moreover, the stages must emerge in an unchanging and constant order in all individuals. However, although the sequence must remain constant, the ages at which stages occur may vary considerably. Another essential characteristic of stages is that a hierarchical relation among the stages exists in which each succeeding stage incorporates its predecessors in its formation. An additional criterion is that each stage forms an integrated whole. The stages are delimited by an initial period of preparation during which behavior is loosely and unstably organized and an achievement period in which the structures are well-organized and tightly knit. It is during this latter period that the integrated character of the stage in question is evident.

Finally, Piaget's concept of décalage, both horizontal and vertical, is important to stage development. In general, décalage refers to similar cognitive developments occurring at different ages across the ontogenetic span (p. 21). In horizontal décalage, a repetition takes place within a single period of development. Piaget's classic example is of the child who can conserve mass a year or more before he acquires conservation of weight. In vertical décalage, the repetition occurs at a distinctly different level of functioning. While formal

similarity exists between the structures at two levels and the content to which they are applied is the same, the actual operations involved are different.

Piaget's developmental taxonomy is concordant with the attributes of the stage concept. He cites three periods or major developmental epochs with stages designating smaller divisions within these; he also uses the terms subperiod and substage when necessary (pp. 85-86). The first period, that of sensory motor intelligence, lasts from birth to 2 years of age. (All age levels are approximations only.) During its six stages, the infant moves from a reflexive level of complete self-world undifferentiation to a relatively coherent organization of sensory motor actions within his immediate environment (p. 86), developing from a purely biological to a social organism. The period of preparation for and organization of concrete operations lasts from ages 2 to 11 with two major subperiods: preoperational representation (ages 2-6) and concrete operations (ages 7-11). In the former, the child first relates to symbols such as language and mental images. Imitation and make believe are prevalent during this time and overgeneralized attempts at conceptualization are important. The latter subperiod is characterized by logical and reversible thought. The logic of classes and relations is understood by the child and he can operate in thought on concrete objects or their representations by coordinating series and part-whole relationships (Pulaski, p. 202). The third and final period is that of formal operations, emerging with adolescence from ages 11 to

15. Thinking is characterized as hypothetico-deductive, abstract, and formal; that is, the child can start with the possibilities and reason from there, he can form pure abstractions and think on an abstract, verbal level and he can distinguish the form from the content of a statement and consider it aside from the specific content (Gorman, 1972, p. 58).

The functional invariants and changing structures of intelligence according to Piaget's theory have been briefly defined and described. However, equilibration, the process by which the functions effect changes in the structures or the rules of transition from one stage to another, is necessary to complete the theory. The equilibration process operates on all exchanges between the subject and his environment, giving rise to successive, discontinuous equilibrium states. Because of the relation between the subject and environment, the process is a balanced coordination of the dual functioning of assimilation and accommodation. Furthermore, the model is a very general construct which implies directional movement from a lower to higher state of ontogenetic development and which assumes the causal contributions of such factors as maturation, learning, social transmissions, and experience.

In summary, Piaget has inferred from his observations of behavioral content that intelligence develops in the individual by invariant functions acting upon changing structures. His genetic-epistemological orientation has caused him to take a broadly biological perspective in devising his model of cognitive ontogenesis.

Ausubel's Assimilation Theory of Learning

Ausubel is an educational psychologist whose cognitive orientation permeates his writing. Rather than create a unique theory of cognitive development, he accepts in general the work of developmental theorists, notably Piaget, and concentrates instead on explicating an assimilation theory of meaningful learning. In brief, his assimilation theory proposes,

> the acquisition of new materials is highly dependent on the relevant ideas already in cognitive structure and that meaningful learning in humans occurs through an interaction of new information with relevant existing ideas in cognitive structure. The result of the interaction that takes place between the new material to be learned and the existing cognitive structure is an assimilation of old and new meanings to form a more highly differentiated cognitive structure. (Ausubel, Novak & Hanesian, 1978, p. 68)

To grasp the implications of this summarizing statement, one must examine more specifically Ausubel's assimilation theory.

True to his role as an educational psychologist, Ausubel primarily considers learning in a school setting. In his view, meaningful reception learning and retention is the principal means of augmenting the learner's store of knowledge both within and outside the classroom (Ausubel, 1963, p. 1). He defines learning as "the process of acquiring

meanings from the potential meanings presented in the learning material and of making them more available" (Ausubel, et.al., p. 51). Retention is "the process of maintaining the availability of a replica of the acquired new meaning" (p. 51). He also deals with transfer which is imparting of prior experience upon current learning (p. 28).

Meaningful learning and reception learning are each poles of two orthogonal continuums. Rote, or memorizing content verbatim, is contrasted against meaningful learning "in which the potential meaning inherent in the external world becomes converted into an individualized psychological state" (p. 35). Reception learning, in which the learning task content is presented to the student in its final state, is the opposite end of the continuum from discovery learning, in which the student independently discovers solutions (p. 16). Ausubel notes that because these learning dimensions are positioned along a continuum, rote and meaningful learning are not completely dichotomous, nor are reception and discovery learning; transitional learning forms do exist.

He distinguishes three kinds of meaningful reception learning: representational, where arbitrary symbols are equated in meaning with their referents (objects, events, concepts); conceptual, learning the criterial (distinguishing or identifying) attributes of a concept; and propositional, learning the meaning of verbal propositions that express ideas other than those of representational equivalence (pp. 47-48). Propositional learning can be further subdivided into subordinate (subsumptive), superordinate, and combinatorial learning.

The process of meaningful reception learning, Ausubel further ex-

plains, is "concerned with having students assimilate subject-matter content in a more active, integrative, and critical fashion" (p. 13). The process of meaningful reception learning involves three sequential states: an implicit judgment of relevance in deciding how to catalog new knowledge, reconciliation of new with existing knowledge, and translation of knowledge into a personal frame of reference consonant with the learner's experiential background (p. 20).

Ausubel states that this process can only be completed successfully if two prerequisites are met. The learning task must be potentially meaningful; that is, if it can be related in a non-arbitrary, substantive (nonverbatim) fashion to what the learner already knows (p. 22). Moreover, the learner must adopt a corresponding learning set to relate the task in this manner (p. 27). What the learner already knows is stored in his cognitive structure (the individual's organization, stability, and clarity of knowledge) which includes "requisite intellectual capacities, ideational content, and experiential background" (p. 23). This cognitive structure is the prime factor affecting meaningful learning and retention. Meaningful materials are related to concepts existing in the cognitive structure especially in the three forms of propositional learning.

The first of these forms, subsumptive learning, occurs when a proposition is related meaningfully to specific superordinate propositions in the pupil's cognitive structure (p. 39). Ausubel postulates two forms of subsumptive learning: derivative and correlative. Derivative learning occurs "when the learning material constitutes a specific example of an established concept in cognitive structure or is supportive or illustra-

tive of a previously learned general proposition" (p. 53). Correlative learning involves assimilating material which is "an extension, elaboration, or qualification of previously learned propositions" (p. 53).

Successful subsumption is dependent upon several variables, first of which is the "availability in cognitive organization of relevant subsuming concepts at an appropriate level of inclusiveness to provide optimal anchorage" (p. 28). This level of inclusiveness is defined as being as close as possible to the degree of conceptualization of the learning task in relation to the learner's cognitive background. In addition to the availability of appropriate subsumers, another variable influencing meaningful reception learning is the extent to which the learning task is discriminable from the cognitive system which subsumes it. The more discriminable the new material, the more likely it is to be retained over the long term. The third major variable in meaningful learning is the stability and clarity of its subsumers. Ambiguous subsumers provide only weak anchorage and poor discriminability (p. 29).

Subsumption is conceived by Ausubel as involving two states: preliminary orienting, relational, and cataloging operations of providing anchorage for the new materials, followed by an obliterative stage in which specific items become progressively less dissociable as entities as they are incorporated into the existing cognitive structure (p. 25). When the item falls below a certain threshold of availability, it is no longer retrievable under normal conditions. Thus, the same process whereby cognitive structure is efficiently modified by new learning is also the cause of forgetting. Ausubel further refines the assimilation theory by emphasizing that assimilation

does not end with the act of meaningful learning; it continues over time and may eventually involve new learning or loss of retrievability of subordinate ideas (p. 127).

Although Ausubel stresses subsumptive learning, he also considers superordinate and combinatorial forms of learning. The former occurs "when a new proposition is relatable to specific subordinate ideas in existing cognitive structure but is relatable to a broad background of generally relestructure that can be subsumed under it" (p. 39). Combinatorial learning takes place when a potentially meaningful proposition can be related neither superordinately or subordinately to the learner's cognitive structure but "is relatable to a broad background of generally relevant content in such structure" (p. 39).

During the course of meaningful learning, two closely related processes take place: progressive differentiation and integrative reconciliation. The first process involves the "progressive differentiation of trace systems of a given sphere of knowledge from regions of greater to lesser inclusiveness each linked to the next higher step in the hierarchy through the process of subsumption" (p. 25). As concepts and propositions are consequently refined, the potential for anchorage of further meaningful learning is enhanced (p. 127). While progressive differentiation is characteristic of subsumptive learning, integrative reconciliation is related to superordinate and combinatorial learning. As new information is gained, existing elements of cognitive structure acquire new organization. This recombination can result in acquisition of new meaning (p. 124). Ausubel specifies that integrative reconciliation is actually a specialized form of progressive differentation (p. 125).

Based on his assimiliation theory, Ausubel advocates a strategy for deliberately manipulating cognitive structure so as to

> enhance proactive facilitation or minimize proactive inhibition [which] involves the use of introductory materials (i.e., organizers) prior to the presentation of the actual learning task. These advance organizers consist of introductory materials at a higher level of abstraction, generality, and inclusiveness than the learning task itself. The function of the organizer is to provide ideational scaffolding for the stable incorporation and retention of the more detailed and differentiated material that follows in the learning passage as well as to increase discriminability between the latter and related interfering concepts in the cognitive structure (p.29).

In lay terms, Ausubel succinctly summarizes the principal function of the organizers as "bridging the gap between what the learner already knows and what he needs to know before he can meaningfully learn the task at hand" (p. 173).

Ausubel sets his assimilation theory of meaningful learning firmly in the context of developmental psychology as he demonstrates in his discussion of concept learning. He notes that during preschool and early elementary years, concepts are acquired mainly by "a process of meaningful hypothesis-oriented concept formation" (p. 87). Only after the concepts are related to many physical exemplars are they incorporated into cognitive structure.

Concrete-empirical props are necessary during the later elementary years for concept assimilation. When the critical aspects of a concept are presented by definition or context, the concept is related directly to the learner's cognitive structure. Beginning with the high school years, the props can be eliminated and critical attributes can be directly related to the learner's cognitive structure. Ausubel further demonstrates the effect of cognitive development when he discusses reception versus discovery learning. Reception learning, although phenomenologically simpler than discovery learning, paradoxically emerges later developmentally, and, particularly in its more advanced and pure verbal forms, implies a higher level of cognitive maturity (p. 26).

To summarize, Ausubel develops at great length his assimilation theory of cognitive learning in which new information is linked to relevant pre-existing aspects of cognitive structure with both the newly acquired information and the pre-existing structure being modified in the process. Based on his model, he describes the cognitive process of subsumption with its underlying principles of progressive differentiation and integrative reconciliation. He sets his theory within the context of school learning and explores at length the types of meaningful reception learning which he believes form the core of the classroom experience.

Synthesizing Research

Especially in the last two decades Piaget's writings have stimulated voluminous research, attempting either to verify or to contradict his theory of cognitive development. While the debate continues about how exactly he has captured the essence of the developmental sequence, his ideas have influenced greatly the field of cognitive psychology. Research stimulated by

Ausubel's work has been narrower in scope; advance organizers have been the most notable pedagogic outgrowth of his system. A large body of research has accumulated supporting the utility of advance organizers in promoting learning, retention, and transfer of meaningful verbal materials. (See Hartley & Davis, 1976; Luiten, Ames & Anderson, 1979; Mayer, 1979.) More specifically, in a series of studies centering around the work of J. T. Lawton at the University of Wisconsin, investigators have examined the effectiveness of advance organizers in relation to Piaget's preoperational and concrete operational subperiods. The body of research, still ongoing, lends considerable support for the efficacy of advance organizers not only to attain the ends described above, but also to facilitate movement from one subperiod of development to another.

Lawton and Fowell (1978) measured the effectiveness of advance organizer lessons in teaching mathematical concepts to preschool children. In one preschool program the selected content dealing with sets was presented in terms of broad concepts; in the second, no broad concepts were emphasized nor were labels and explanations stressed. The treatment extended over seven weeks with the groups meeting twice weekly. The pre- and posttest battery consisted of eight individually administered Piagetian tasks requiring classification and counting skills. A t-test analysis of the posttest data indicated that the experimental group performed significantly better than did the control group ($p < .01$). Despite the clear reporting of material and tasks,

however, the investigators used intact groups and did not control incidental effects the preschool teachers may have had on the subjects during the course of the study.

Adopting a different emphasis, Lawton (1977b) used Piaget's theory of cognitive development to measure differences in use of logical operations of classification by 6 and 10 year olds. He distinguished between subject-matter and process concepts in the two-phase study that included advance organizer, subsequent and introductory lessons. The advance organizer lesson used both subject-matter and process concepts to teach high order rules using picture cards of food, dwellings, and tools of primitive and modern man. Subsequent and introductory lessons were taught at a lesser level of generality. Subjects were tested individually on four classification tasks but were taught in small groups. Phase One consisted of pretest, treatment, and posttest; Phase Two followed the same procedure to examine the effects of the first advance organizer in facilitating sequential transfer. Comparisons of the results of chi-square tests indicated that experimental groups generally performed significantly better than control groups. Accelerated use of logical operations by 6-year-olds proceeded beyond the stage expected for this age group. In comparing Phase Two with Phase One, it was found that sequential transfer occurred between like subject-matter concepts and logical operations. A ceiling effect on the task measuring "some and all" may have distorted results.

Lawton and Wanska (1978) looked at the content rather than the form of the advance organizer in their study with children in three age groups: kindergarten, first, and third grades. Their advance organizer lessons trained the subjects to acquire content concepts dealing with ideas about how people satisfy certain basic needs, process concepts such as hierarchical classification and relations, or both. The study involved two sequentially related experiments, each with its own pre- and posttest, lasting approximately six months in total. Overall findings from analysis of variance favored the three experimental groups over the control ($p < .05$) with the combined content/process organizer functioning the best. The findings supported the contention that near-near and near-far transfer occurred. Unfortunately, the investigators presented no evidence that the advance organizer or introductory lessons were followed by subsequent lessons. Therefore, the advance organizer became the lesson as well as the precursor to it, thus changing the concept considerably from Ausubel's formulation.

In yet another study, Lawton and Wanska (1979) varied the conditions in the two experiments cited above to answer three questions: Is hierarchical classification differentially susceptible to training by high order content concepts, rules for hierarchical classification, or a combination of both? To what extent is learning under each of these conditions durable? What is the extent of near-near or near-far transfer under each of these conditions? The 237 kindergarten, third and fifth

grade subjects were assigned to one of four groups: subject organizer (A01), taught high order social studies content concepts related to primitive and modern man; process organizer (A02), taught high order rules for hierarchical classification; combined subject/process organizer groups (A03), given the same instructions as the previous two groups; and control (C), taught an introductory lesson consisting of factual information or low order concepts. Instructional sessions were taught in groups of seven to ten children. Again, the advance organizers were not followed by subsequent lessons. The study, lasting approximately six months in all, was composed of two sequentially related experiments, Phase One and Phase Two, each having a pre- and posttest. Results of analysis of variance procedures applied to the data supported ($p < .05$) the contention that combining high order content concepts and high order rules for structuring content enhanced performance on classification tasks more than either type separately. In addition, analysis of variance of the results confirmed that improvements in performance were durable since the groups remained stable between Phases One and Two ($p < .05$) and after five months ($p < .01$). That positive near-near transfer occurred in all experimental groups was supported by analysis of variance of data from Phase Two and the delayed posttest and transfer test.

Again using social studies content of how various communities satisfy basic needs, Lawton (1977a) explored the effect of advance organizer lessons on children's use and understanding of the causal

and logical "because." Subjects, 120 children, ages 6 to 7 and 10 to 11 years, were randomly assigned to one of three groups receiving different instruction: an advance organizer lesson followed by a subsequent lesson (E_1); advance organizer alone (E_2); and introductory lesson followed by the subsequent lesson (C). The advance organizer lesson consisted of higher order concepts (e.g., stone hand tools, mechanical tools, simple tools, modern tools) incorporated into relationships between communities of men and how they used tools, food, and shelters in order to survive. The subsequent and introductory lessons were composed of specific facts and low order concepts (e.g., stone axe, electric drill). The pretest and posttest were sentence completion tasks requiring the use of the causal and logical "because" following the reading and slide presentation of a short story which described sequences in the life of certain communities of man. The first study was replicated five weeks after the first posttest with different content to measure transfer of learning from the first study and to measure any further sequential transfer from a second advance organizer lesson or advance organizer followed by a subsequent lesson.

Results of the chi-square analysis of the first study showed that in most cases experimental groups significantly improved their performance on the posttest ($p < .01$). Experimental groups performed significantly better than control groups ($p < .05 - .01$), although there were no significant differences between the E_1 and E_2 groups. Posttest performances indicated that along with an increase in quality of type of

response, there had been significant improvement in understanding of logical implications and causal explanations. For the second study results showed that on the pretest experimental groups maintained the level of performance reached previously compared to no improvement by the control group.

Swadener and Lawton (1977) studied the effects of two types of advance organizers, an expository organizer, and a guided self discovery organizer in teaching hierarchical classifications or relations to preschool children. The expository organizer lessons followed the principle advocated by Ausubel of moving from the general and familiar to the specific and new by demonstrations, activities, and discussion with the children. The guided self-discovery organizer asked hierarchically sequenced questions which encouraged subjects to discover properties and relationships between and among materials. Although both experimental conditions were taught by the experimenters, the control group was taught by regular teachers unaware of the study's objectives who conducted instruction in their usual fashion using a list of suggestions generated by experienced classroom teachers. The same materials were used by all three groups although the strategies differed. The three lessons of 25 minutes each took place over two weeks and all pretests and posttests were individually administered. Multi- and univariate analyses applied to the results of eight measures of concrete operations revealed that both organizer groups outperformed the control group, and performance by expository organizer groups was

significantly superior to guided self-discovery groups ($p < .05$). The effectiveness of the expository organizer method was evidenced by the duration of the training effects up to 10 weeks after instruction ($p < .05$).

Most recently, Lawton and Ershler (Note 1) have studied the effects of three instructional programs on the learning of three-year-old preschoolers: a formal program following Ausubel's assimilation theory and two informal programs, Piagetian and Traditional. In the Ausubelian program, learning was arranged in small group instruction to present both general subject-matter concepts and higher order rules for performing logical operations with active manipulation of concrete learning materials. The Piagetian program stressed stimulating cognitive growth while ensuring growth of knowledge through actions in a spontaneous manner. Small group activities presented a function such as classifying and then children were encouraged but not taught to apply the function. The Traditional program was similar to the Piagetian approach without teachers basing their functions on any particular learning or developmental theory. Subjects were pretested on a battery of Piagetian tasks and then followed their respective programs for six weeks. A multivariate analysis of variance applied to the posttest data after 16 weeks indicated significant between-group differences following training, with children in the Ausubelian program performing superiorly on dichotomous sorting, spontaneous classification, class inclusion, serial ordering, additive seriation, and serial correspondence.

There was little difference in performance between the Piagetian and Traditional program groups. These findings were presented as an interim report; the final results from the three-year longitudinal study will not be available until 1981.

The body of related research which has been reviewed indicates that properly designed and implemented advance organizers result in enhanced learning, retention, and transfer and in accelerated cognitive development in children in the preoperational and concrete operational subperiods. The research furthermore supports the use of an advance organizer structure that starts with higher order rules before moving to specific materials. Both subject-matter and process concepts are effective types of advance organizers and the combination of the two provides the best aid to learning. The advance organizer concept, generated from Ausubel's assimilation theory of learning, apparently facilitates cognitive development as described by Piaget; empirically, the two theoretical vantages are compatible.

Theoretical Comparison and Contrast

Are the theories of Piaget and Ausubel basically compatible or do they differ on too many major issues for their ideas to be used in conjunction with one another? Answering this question is complicated by the fact that while Ausubel comments liberally about Piaget in his book Educational Psychology: A Cognitive View, there are no sources of Piaget's response to Ausubel's thinking. Therefore, Ausubel's perspective will be adopted in this discussion. Through comparison

and contrast on selected issues perhaps the question can be at least partially answered.

Ausubel primarily accepts Piaget's stage-dependent theory of cognitive development. In responding to critics of Piaget's work, he states, "Actually, developmental stages imply nothing more than identifiable sequential phases in an orderly progression of development that are qualitatively discriminable from adjacent phases and generally characteristic of most members of a broadly defined age range" (Ausubel et.al., p. 225). He further says as long as the stages emerge in the same sequence in all individuals, stage theory is compatible with intraindividual, interindividual, and intercultural differences in age level of occurrence and in subject-matter field. Also, the developmental stages reflect both genic and environmental factors.

In his consideration of school learning, however, Ausubel eschews Piaget's complex arrangement of periods, subperiods, stages and substages. Instead, he stipulates three general stages in children's cognitive development differing most significantly along the concrete-abstract dimension: the preschool child can generally understand concepts only if their criterial attributes can be related to multiple exemplars of the concept before relating it to cognitive structure; the elementary school child can understand the meaning of a concept by relating the criterial attributes directly to cognitive structure with the aid of concrete-empirical examples of those attributes; and

the secondary student can understand and manipulate abstract ideas and relationships among them directly, without the benefit of concrete props (p. 206).

Although Ausubel basically accepts Piaget's theory as valid, he does take exception to some of Piaget's formulations when specifically applied to education. The points of difference he lists include: Piaget is concerned solely with the development of thought as opposed to comprehension; by identifying the operations of thought with the operations of logic, Piaget confuses a special tool of thought with the actual operations of thought in problem solving situations; Piaget attributes to thought the quality of implicit action in contrast to the widely accepted view of thinking as a reorganization of elements in cognitive structure to meet the requirements of a situation; Piaget places prime emphasis on endogenous motivation, largely ignoring education's role of stimulating the development of new motivations from existing potentialities; Piaget discounts education's role in promoting cognitive development, placing instead great emphasis on spontaneous or incidental experience; Piaget denies the role of education in accelerating cognitive development or in facilitating transfer from one stage to another; and Piaget believes the function of language is communicative, attributing to it no operative role in thought (p. 231). Although not every issue raised by Ausubel will be addressed, these critical comments will be used as a loose framework to discuss more specifically some similarities and differences between Piaget and Ausubel.

The third issue raised by Ausubel, that Piaget conceives of thought as action in opposition to thought as reorganization of cognitive structure, represents a basic difference between the two men. Piaget emphasizes the processes of thought while Ausubel focuses more on the manipulation of content. Ausubel says the belief that "it is feasible to teach general cognitive operations isolated from actual subject-matter content not only makes excessive demands on children, but is also artificial in terms of particularized contents which such skills necessarily assume in each discipline" (p. 231). Shulman, in discussing the relation of psychology to mathematics education, describes Ausubel's stance strongly: "He remains a militant advocate of the importance of mastering well-organized bodies of subject-matter knowledge as the most important goal of education" (Begle, 1970, p. 36). In a paper proposing assimilation theory as an alternative to Piagetian psychology, Novak (1977) explores this same dichotomy by saying, "The key issue....is whether children develop general 'cognitive structure' or 'cognitive operations' to make sense out of experience, or, if instead, they acquire a hierarchically organized framework of specific concepts, each of which or some combination permits them to make sense out of an experience..." (p. 455). Novak would support the latter position. Ausubel summarizes his position, albeit somewhat simplistically, when he writes in the frontispiece to the second edition of Educational Psychology: A Cognitive View, (1978), "The most important single factor influencing learning is what the learner already knows. Ascertain

this and teach him accordingly."

Another point of difference identified by Ausubel is that Piaget believes the most important form of motivation to be endogenous, or originating within the individual, which in turn, suggests discovery learning as the most effective type of education. The teacher's role in Piaget's conception of discovery learning is to analyze the contents to be learned in terms of the operations implicit in it. Based on the analysis, the teacher arranges the learning materials so that these operations can be carried out by the student and ascertains that the student does indeed carry them out (Flavell, p. 368). Piaget in fact favors discovery learning for all children, while Ausubel suggests that meaningful reception learning is most appropriate for children in upper elementary and secondary school who have acquired a basic conceptual store. As Shulman concludes, "Ausubel would view the child's level of cognitive development, however attained, as a major criterion in selecting among instructional tactics" (Begle, p. 65). Ausubel explains that the nature of the abstract stage of cognitive functioning permits individuals to learn most new concepts and propositions directly, grasping verbally or symbolically stated relationships between previously learned abstractions. Because of developmental advancement, "individuals are ready at the secondary school level for a new type of verbal expository teaching that uses particular examples primarily for illustrative purposes -- that is, to clarify or dramatize truly abstract meanings rather than to make possible the

emergence of intuitive meanings" (Ausubel et.al., p. 252).

While the difference in emphasis on discovery versus reception learning by these two men is clear, their translation of the implications of formal operations for instruction is less oppositional. In particular, the function of language emerges as an issue. Although Ausubel implies that Piaget posits that language has no operative or process role in thought, he is being overly simplistic in his interpretation. Piaget does stress that during the sensory motor period of development "representational thought does not begin with and result from the incorporation of verbal signs from the social environment" (Flavell, p. 155).. Rather, symbolic representation leads to the acquisition of language. However, in contrasting his proposed active method against receptive methods, Piaget himself emphasizes that the activity need not always involve physical manipulation of objects. For older children "the most authentic research activity may take place in the spheres of reflection, of the most advanced abstractions, and of verbal manipulations (provided they are spontaneous and not imposed on the child at the risk of remaining partially uncomprehended)" (Piaget, p. 68).

Related to the emphasis on discovery learning, Ausubel states that Piaget stresses spontaneous or incidental experience over formal education in promoting cognitive development. Ausubel somewhat

resolves the conflict by stipulating two types of readiness occurring within the individual: specific and general. General readiness reflects a cumulative product of genic effects, incidental experience, and learning in which subject-matter learning affects cognitive capacities in a general way. Specific or subject-matter readiness, in contrast, is based on acquiring prerequisites for particular learning. "Experience or learning any subject-matter produces general as well as specific developmental changes in cognitive capacity in addition to specific changes in subject-matter readiness" (Ausubel et.al., p. 249).

Piaget also categorizes cognitive achievement along a general-specific continuum, particularly for the adolescent, albeit in a more structured manner than does Ausubel. Most general is the group-lattice structure of formal thought; most specific are task linked concepts emerging from work with Piagetian experiments. Formal operational schemata are intermediate in generality and can be applied across a range of problems (Flavell, p. 222). Therefore, a general cognitive structure indeed emerges for Piaget, but its formation is augmented by specific task-concepts of subject-area content.

Having distinguished between two levels of cognitive development, Ausubel continues by suggesting that appropriate school experiences can accelerate more general development, particularly that of transition from one level of operations to another. He is especially interested in the transition from concrete to abstract thinking. While Piaget concedes that some acceleration, albeit necessarily limited in extent, is

certainly possible, Ausubel emphasizes the role of training and education.

The general training procedure he describes takes place in anticipation of the next higher developmental period after the current stage is fairly well consolidated. To move from the preoperational to concrete operations periods, he proposes "training the child under the learning conditions that apply to the latter stage, by requiring him or her to relate secondary abstractions and abstract verbal propositions to cognitive structure with the aid of concrete-empirical props" (Ausubel et.al., p. 249). To move from concrete to formal operations, he suggests "gradually withdrawing the concrete-empirical props as the prior stage becomes consolidated -- that is, by withdrawing the props well in advance of the actual attainment of abstract cognitive functioning" (p. 249-250). He concludes, "On theoretical grounds there is no reason why only incidental (spontaneous, undirected, unexplained) experience (despite Piaget's insistence to the contrary) must effect the gradual cumulative change in intellectual capacity that makes transition to a higher stage possible" (p. 248).

Again, despite Ausubel's insistence to the contrary, Piaget suggests a similar instructional approach. Because of the importance to Piaget of the key concept of gradual transformation of overt action into mental operations, Piaget indicates that the teacher should assist this process by encouraging the student to work with progressively less direct support from the external givens (Flavell, p. 368). Ultimately,

the external actions can take place internally and in complete autonomy from the environment.

Finally, in considering the concrete and abstract periods of cognitive development as well as the transition between them, Ausubel makes some distinctions between Piaget's thinking and his own that seem to differ more in emphasis than in substance. Without explicitly using Piaget's term décalage, Ausubel iterates that the movement from concrete to abstract functioning must occur separately in each discipline. He does hypothesize, however, that the general overall stage of development is transferable to the new discipline. This is due to "the existence of a large body or 'critical mass' of stable abstractions in cognitive structure and of sufficient transactional terms for relating them to each other, as well as considerable experience in comprehending and manipulating abstract ideas without the benefit of concrete props in other disciplines" (Ausubel et.al., p. 206). Therefore, while the individual who has achieved formal thought must move anew through concrete to abstract reasoning in each new discipline, the process is greatly accelerated.

Furthermore, he identifies a different critical feature as the quality distinguishing between concrete and formal operations. For Piaget, this feature is that the more advanced child "is able to deal internally with ideas about ideas or to perform 'second order operations'" (p. 237). Ausubel modifies this view considerably by stating, "It is rather the preadolescent's and adolescent's ability verbally to manipulate

relationships between ideas in the absence of recently prior or concurrently available concrete-empirical proofs that is the distinctive attribute of formal operations" (p. 237). He supports this premise by maintaining that concrete operational children can draw correct inferences from hypothetical premises involving abstract relations.

Ausubel recognizes a general similarity between Piaget's formulation of the assimilation process and his own assimilation theory. This similarity stems from the provision in Piaget's view of assimilation for the absorption of new into existing schemata which is generally analogous to subsumption. Ausubel quickly adds, however, that "not only does Piaget fail to go beyond this general statement of assimilation and describe explicitly how assimilation occurs, he also conceives of assimilation solely in terms of developmental progressions rather than in terms of a contemporaneous learning process" (p. 231).

Difficulties stemming from two different definitions of the same word -- assimilation -- exemplifies how confusing terminology overshadows some of the interrelatedness which actually does exist between the two theories. For instance, the two types of subsumptive learning, derivative and correlative, are roughly akin to assimilation and accommodation although the relation Ausubel identifies is between assimilation and subsumption. More formally, Ausubel's assimilation theory of meaningful learning involving progressive differentiation and integrative reconciliation appears to be analogous to adaptation with its complementary processes of assimilation and accommodation.

Perhaps the difficulty again arises because Piaget's emphasis is on general development while Ausubel's concern is learning within the school setting.

The previous discussion comparing and contrasting the theories of Piaget and Ausubel has shown that while the ideas of the two are basically complementary, some notable differences do exist between them. Piaget stresses the processes or operations of thought; Ausubel emphasizes the importance of content as the basis of cognitive structure. Discovery learning seems to be the way of fostering cognitive development for Piaget; Ausubel sees meaningful reception learning as the prime vehicle for most school learning. Piaget concentrates on the general functions of equilibrium, equilibration, and adaptation as accounting for cognitive development; Ausubel recognizes a general developmental process but also sees a particular subject-matter related procedure affecting the individual's development. Piaget does not address as crucial the role of institutionalized education in promoting cognitive growth; Ausubel firmly believes transition during the individual's development can be fostered by educative means.

While the theoretical formulations of these two men do not match point-for-point, no irreconcilable inconsistencies emerge which preclude consideration of their work in tandem. Ausubel's perspective on the discrepancy in their respective theories perhaps exacerbates rather than minimizes the difference between them; he sometimes overstates unnecessarily or misinterprets some of Piaget's tenets. Piaget presents

a general developmental model to account for cognition while Ausubel focuses on the learning process in his cognitive theory. In responding to Novak's case for assimilation theory as an alternative to Piaget's work, Albert (1979) concludes, "One should view Ausubel's theory as complementary to Piagetian developmental psychology rather than in conflict with it.....His framework should be viewed as adding a practical dimension to Piaget's theory of cognitive development" (Albert, pp. 138, 135). Her point is well taken.

Implications

The explication and comparison of the theories of Jean Piaget and David Ausubel in conjunction with the review of the accumulating body of related research evidence indicate that the two cognitive theories are compatible and perhaps even complementary. From this assumption, pedagogic implications emerge particularly for the use of advance organizers in instruction. Although the discoveries and technology of today's world are engendering an ever-accelerating movement towards tomorrow's reality, the bulk of the learning in the schools continues to be that of meaningful verbal materials. In fact, because of burgeoning knowledge, the amount of materials learned has increased exponentially. How to facilitate learning, retention, and transfer of meaningful verbal materials is a prime concern of education. Appropriately designed and implemented advance organizers appear to be one means to this end.

Moreover, Piaget posits that cognitive ability varies qualitatively with the developmental stage, suggesting that different types of instruction are more appropriate than others at specific developmental points. That carefully designed advance organizers have been proven to be facilitative in preoperational and concrete operational children is consistent with this position. The weight of the research evidence in support of these points gives credence to systematically using advance organizers in the classroom. (See Searls, Note 2, for specific guidelines.)

However, the scope of the research combining the two theoretical bases has been limited largely to work with young children and some serious methodological problems have been evident. Additional work needs to be undertaken with children of different age groups. Pertinent research questions include:

1) Do advance organizers affect learning differently for children in the concrete, transitional, and formal operational periods?
2) Can advance organizers facilitate the transition from concrete to formal periods of cognitive development?
3) Is there an interaction between type of advance organizer and level of cognitive development?
4) What forms of advance organizers are most useful in helping young people cope successfully with meaningful verbal materials, especially at the secondary level?

Endeavors to answer these and related questions form the mid-stage in the progression from theory through research to practice. By systematically testing hypotheses generated jointly from the cognitive theories of Piaget and Ausubel, two vital educative ends can be fostered: maximizing the cognitive development of the individual and improving learning of verbal materials. Both are goals worthy of considerable effort.

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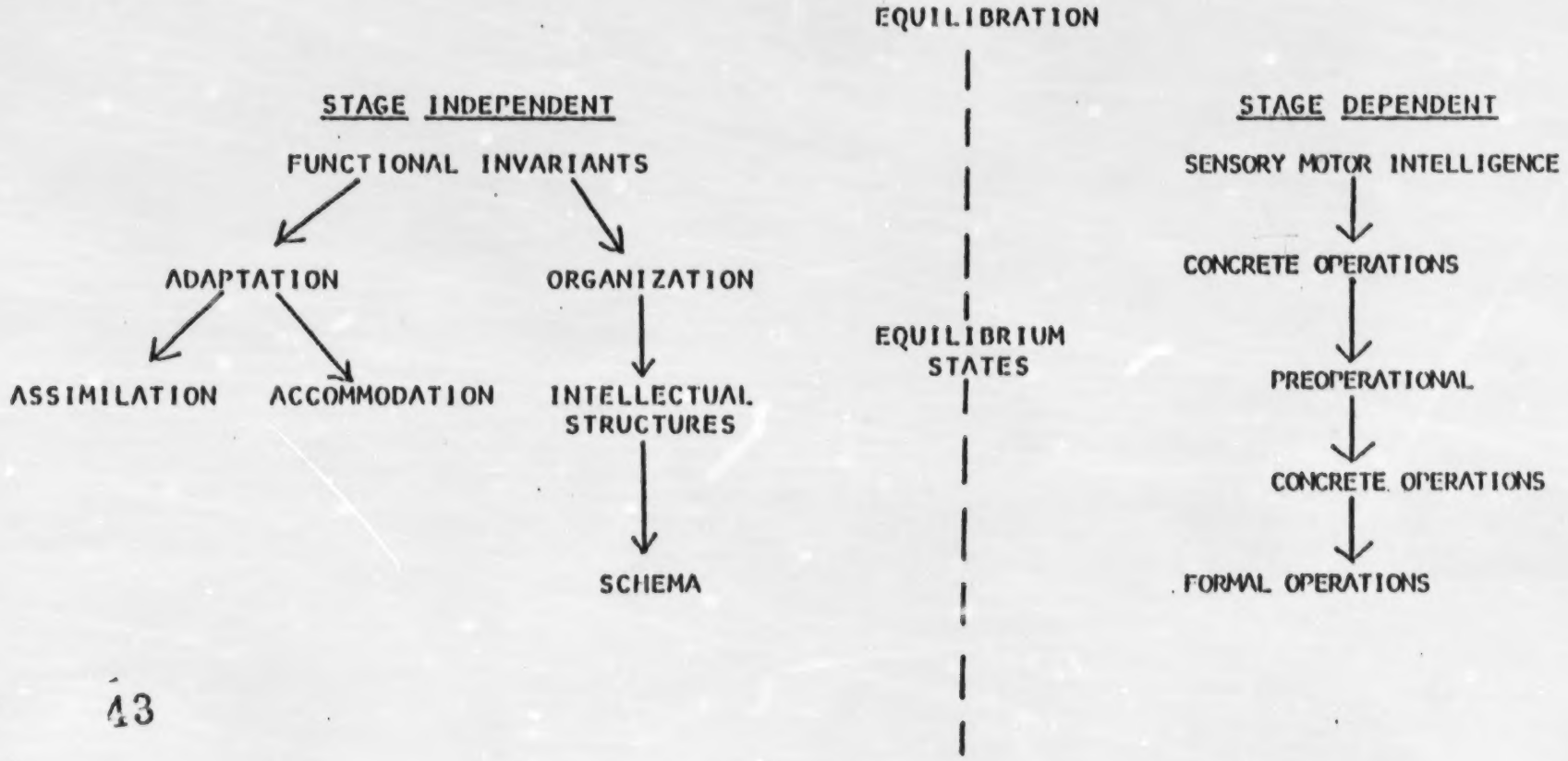
Figure Captions

Figure 1. Structured overview of Piaget's theory of genetic epistemology.

Figure 2. Structured overview of Ausubel's assimilation theory of meaningful learning.

PIAGET'S THEORY OF GENETIC EPISTEMOLOGY

(Cognitive Development)



AUSUBEL'S ASSIMILATION THEORY OF MEANINGFUL LEARNING